

**Test Report:
Total Ionizing Dose Response of OP200**

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1. Introduction

The response of the OP200 to total ionizing dose radiation was measured after various exposure levels up to a dose of 50 krad (Si). The testing was carried out in August 2006.

2. Part Information

The OP200 is a Dual Low Offset, Low Power Operational Amplifier manufactured by Analog Devices. Being a bipolar part, it was tested at low dose rate (~20 mrad(Si)/s) to check for Enhanced Low Dose Rate Sensitivity (ELDRS). Table I gives the relevant part information and test conditions. Fig. 1 shows the pin-out for the OP200.

Table 1.
Part and Test Information

Generic Part Number:	OP200
Manufacturer:	Analog Devices
Lot Date Code (LDC):	0237A
Quantity Tested:	5
Serial No's of Control Sample:	5
Serial No's of Radiation Samples:	1, 2, 3, 4
Part Function:	Dual Low Offset, Low Power Operational Amplifier
Part Technology:	Bipolar
Package Style:	8 lead CERDIP.
Test Equipment:	Parametric Analyzer, dual power supply
Test Engineer:	Forney
Dose Levels (krad (Si))	0, 3.6, 6, 11, 16, 21, 40, 50
Target dose rate (rad (Si)/sec)	20 mrads/s

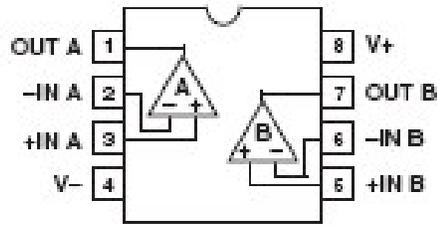


Fig. 1. Pin-out for the OP200

3. Conditions During Irradiation

For irradiation exposure under bias, the part was configured as a voltage follower with $V+ = 15V$ and $V- = -15V$. The outputs were left floating and the inputs were grounded. The part was exposed to gamma radiation in a Co^{60} cell at NASA-GSFC at a dose rate of approximately 20 mrad(Si)/s.

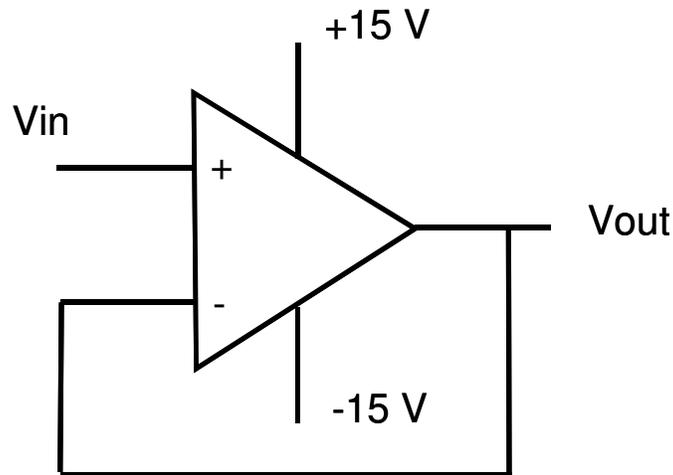


Fig. 2. Bias circuit for the OP200 during exposure to ionizing radiation.

4. Part Evaluation

Prior to irradiation, parametric testing and functional testing were performed on the 5 parts using a parametric analyzer. The tests were repeated after each incremental dose up to 50 krad(Si).

5. Results

The results of the testing are shown in Tables II, III, IV and V.

Table II
Positive Input Bias Current (A)
(Specified to be 5 nA)

TID	Iin(+)				Average	St. Dev.
	DUT #1	DUT #2	DUT #3	DUT #4		
0	-1.82E-11	-9.82E-11	-7.20E-11	-7.98E-11	-6.71E-11	3.44E-11
3.5	-4.71E-10	-5.58E-10	-6.09E-10	-5.95E-10	-5.58E-10	6.19E-11
6	-1.39E-10	-5.45E-10	-7.57E-10	-6.81E-10	-5.30E-10	2.76E-10
11	-3.47E-10	-5.15E-10	-5.68E-10	-5.93E-10	-5.06E-10	1.11E-10
16	1.79E-09	1.71E-09	1.28E-09	1.48E-09	1.57E-09	2.31E-10
21	2.79E-09	2.47E-09	1.91E-09	2.35E-09	2.38E-09	3.61E-10
40	1.02E-08	9.83E-09	9.23E-09	9.86E-09	9.78E-09	4.07E-10
50	1.49E-08	1.40E-08	1.33E-08	1.42E-08	1.41E-08	6.61E-10

Table III
Positive Supply Current (A)
(Specified to be 1.55mA)

TID	I(+)				Average	St. Dev.
	DUT #1	DUT #2	DUT #3	DUT #4		
0	7.75E-04	9.52E-04	7.57E-04	8.85E-04	8.42E-04	9.27E-05
3.5	9.44E-04	9.24E-04	9.37E-04	9.09E-04	9.29E-04	1.52E-05
6	9.34E-04	7.84E-04	9.30E-04	8.54E-04	8.76E-04	7.11E-05
11	7.51E-04	8.98E-04	9.15E-04	8.38E-04	8.50E-04	7.40E-05
16	4.82E-04	5.68E-04	4.69E-04	5.20E-04	5.10E-04	4.44E-05
21	8.34E-04	6.30E-04	6.45E-04	6.11E-04	6.80E-04	1.03E-04
40	4.49E-04	4.44E-04	4.68E-04	4.40E-04	4.50E-04	1.25E-05
50	4.43E-04	4.39E-04	4.42E-04	4.35E-04	4.40E-04	3.81E-06

Table IV
Input Offset Current (A) with OP200 Configured as a Voltage Follower.
(Specified as 2.5 nA)

IOB						
TID	DUT #1	DUT #2	DUT #3	DUT #4	Average	St. Dev.
0	3.39E-11	2.63E-11	6.52E-11	5.98E-11	4.63E-11	1.91E-11
3.5	1.01E-11	3.69E-11	3.98E-11	6.30E-11	3.75E-11	2.17E-11
6	3.80E-11	-2.30E-11	-9.93E-12	8.16E-11	3.81E-11	3.12E-11
11	1.95E-11	2.44E-11	-1.38E-11	7.00E-11	3.19E-11	2.57E-11
16	-9.80E-11	4.76E-11	2.83E-11	1.67E-11	4.77E-11	3.59E-11
21	-4.45E-11	2.21E-11	-6.56E-12	-3.53E-11	2.71E-11	1.65E-11
40	2.90E-11	-2.88E-11	1.13E-10	6.13E-11	5.80E-11	3.96E-11
50	6.77E-11	5.26E-11	4.28E-11	9.99E-11	6.57E-11	2.50E-11

Table V
Input Offset Voltage (V) measured with OP200 configured as a Voltage Follower.
(Specified as 75 μ V)

Voff						
TID	DUT #1	DUT #2	DUT #3	DUT #4	Average	St. Dev.
0	-4.50E-05	-5.00E-05	0.00E+00	0.00E+00	-1.25E-06	3.88E-05
3.5	-5.00E-05	-9.00E-05	-4.00E-05	-4.60E-05	5.65E-05	2.27E-05
6	-2.50E-05	-9.00E-05	-2.50E-05	-8.50E-05	5.63E-05	3.61E-05
11	-5.50E-05	-6.00E-05	0.00E+00	-3.00E-06	2.95E-05	3.24E-05
16	-4.00E-05	-4.80E-05	2.50E-05	0.00E+00	2.83E-05	2.11E-05
21	-6.00E-05	-5.50E-05	1.50E-05	-1.00E-05	3.50E-05	2.61E-05
40	-1.00E-05	0.00E+00	9.50E-05	2.00E-05	3.13E-05	4.33E-05
50	-2.00E-05	-1.00E-05	8.50E-05	2.00E-05	3.38E-05	3.45E-05

6. Conclusions

The supply currents, input offset voltage, and input offset current remained within specifications up to 50 krad(Si). The input bias current went out of specification between 21 and 40 krad(Si).